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Optical Performance of Ho:YLF Q-switched Tm:YAG Laser System

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Abstract

The absorption cross-section of the Ho:YLF crystal is close to the emission cross-section of the Tm:YAG laser. According to the passive Q-switching theory, a giant laser pulse cannot be generated from the Ho:YLF Q-switched Tm:YAG laser system unless an internal focusing lens is utilized. In a previous work we experimentally demonstrated that passive Q-switching of the 2017-nm, flashlamp pumped Tm,Cr:YAG laser with a Ho:YLF saturable absorber could be obtained with an internal focusing lens. In this paper, we theoretically investigate the optical performance of the Ho:YLF Q-switched Tm:YAG laser system by solving the coupled rate equations. The simulation results indicate that the results obtained numerically are in good agreement with that obtained experimentally. Moreover, we study the passive Q-switching performance of the Ho:YLF Q-switched Tm:YAG laser system as functions of the reflectivity of the output coupler, the initial population of the saturable absorber ground state, the laser pumping rate, and the loss inside the laser resonator. On the other hand, assuming that a polarizer is utilized inside the laser cavity, we explore the passive Q-switching performance of the Ho:YLF Q-switched Tm:YAG laser system when the polarization of the laser light is along different direction between the two saturable absorber principal axes. Effect of the relative position between the saturable absorber and the output coupler is also investigated.